Yanbu Industrial College

Department of Electrical Power Engineering Technology

EEET 103 Electrical Machines I

Lab Exercise No. 06

Title **NO-LOAD CHARACTERISTICS OF DC SHUNT WOUND GENERATOR**

Student Name: _____ **Student ID:** _____

Submission Date: _____ **Lab Section:** _____

Important Notes

1. Every student must write Name, Section, and Lab exercise No, Title, ID Number and Submission Date clearly in provided space.
2. Only neat, clean and hand written reports on this prescribed format given in E-learning will be accepted.
3. Students are encouraged to work and study together as team work is highly recommended.
4. No credit will be given for works that are copied from any source.
5. Assignments and reports must be turned in on time.
6. Please make photocopy of your lab report before submission as original may not be returned to you.
7. In case of late submission 20% of total credits will be reduced per day.

For Instructor's use only.	
Date Received	
Maximum Marks	**10**
Late By	**days**
Deductions	**%**
Marks Obtained	
Comments (If any)	

Signature: _____

NO-LOAD CHARACTERISTICS OF DC SHUNT WOUND GENERATOR

PERFORMANCE OBJECTIVES:

Upon completion of this laboratory experiment, the student will be able to:

- Connect and operate a Separately Excited DC Generator and record the No-load Characteristics at constant speed.
- Connect and operate a Self Excited DC Shunt Wound Generator and record the No-load Characteristics at constant speed.
- Plot and describe the No-load characteristics curve (V_0/I_F) of a DC shunt generator.
- Recognize and explain the differences between the two kinds of excitation from the curves.

EQUIPMENT:

1. DM-100 DC Machine operating as a generator.
2. DYN-100 Dynamometer operating as a motor.
3. 0-125 volt Hampden variable DC power supply, 5 amps.
4. 0-150 volt Hampden variable DC power supply, 1 amp.
5. Two Hampden DC Voltmeters.
6. Two Hampden DC Ammeters.
7. Tachometer.

DISCUSSION:

Separately-excited DC Generator

In the case of a Separately-excited DC generator, the field winding is supplied by a separate voltage source. As a result, the field current can be set independently either directly with a variable voltage source or via a field regulator (rheostat). Normally, the speed is kept constant.
In actual practice the generator is designed so that, in the case of nominal load, the full nominal voltage is present at the terminals of the armature circuit.

Self-excited DC Shunt Wound Generator

The electrodynamics principle discovered by Werner Von Siemens is the theoretical foundation for this generator. Consequently for self-excitation the generator always requires a small residual magnetism for the generation of a small residual voltage.

The field winding is parallel to the armature circuit and in series with the field regulator. The field winding and the field regulator are to be connected in such a fashion that the small exciter current from the residual voltage supports the residual magnetism of the iron core and does not cancel it out.

The generator “rocks” itself up to its maximum no-load voltage within a brief period of time. Here again, after an initially proportional increase of V_0 with an ever increasing exciter current, saturation occurs: the no-load voltage increases less and less.

CIRCUIT CONNECTIONS (SEPARATELY EXCITED DC GENERATOR)

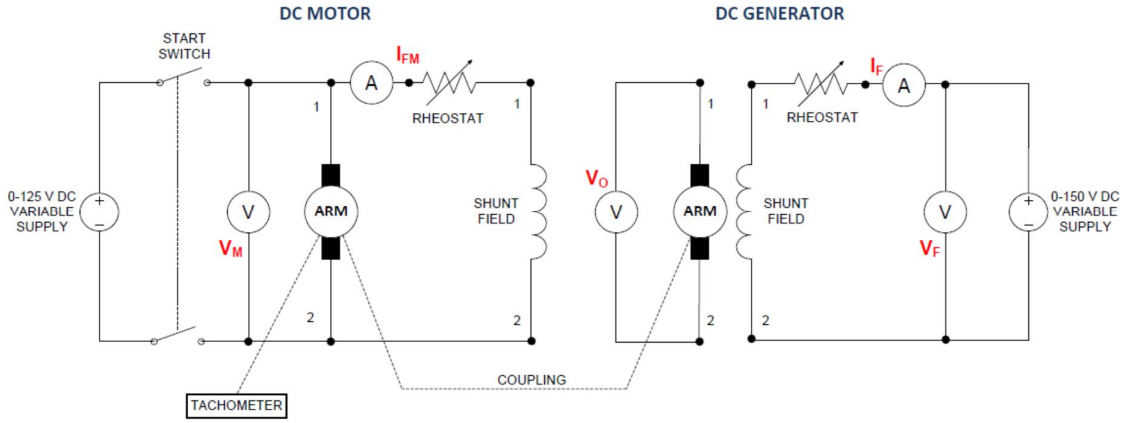


Figure 1.1

PROCEDURE:

1 Place the two machines on the bedplate with the motor on the left and the generator on the right.

2 Couple the machines tightly using the coupling. Be sure the coupling fits snugly inside both shafts.

3 Clamp the machines tightly to the bedplate.

4 Make the motor connections shown in Fig. 1.1 but do not turn the power ON yet. Turn the knob of the 0-125 variable DC supply fully counterclockwise to its zero position. Turn the motor's field rheostat knob fully counterclockwise to its minimum resistance position.

5 Make the generator connections shown in Fig. 1.1 but do not turn the power ON yet. Turn the generator's field rheostat knob fully counterclockwise to its maximum resistance position. Turn the knob of the 0-150 volt supply fully counterclockwise to its zero position.

6 Have the teacher check your connections to be sure they are correct.

7 Turn ON the main AC circuit breaker; turn ON the 0-125 volt DC supply circuit breaker; and turn ON the circuit breaker switch that starts the motor.

8 Slowly turn the knob of the 125 volt supply fully clockwise to its maximum output position. The motor should now be running. With the tachometer directed at the motor shaft, turn the motor's field rheostat knob clockwise until the motor is rotating at 1800 rpm.

9 At this point there is no current in the field coil. However, if the field pole pieces have been magnetized before, they will have enough residual magnetism in them to produce a voltage at the generator's terminals. Record this voltage in observations Table 1.

10 Slowly turn the knob of the 0-150 volt excitation supply until the ammeter reads approximately 0.05 amps of field current. It is not important that the field current be exactly 0.05 amps. If you overshoot, stop and take your reading there.

11 Record the exact value of field current and generated voltage in observations Table 1

12 Repeat Steps 10&11 for the approximate values of field current given in the observation Table 1.

13 Turn OFF all circuit breaker switches. Disconnect all leads.

CAUTION!

1. **High voltages are present in this experiment. Do not make any connections while the Power is on.**
2. **The power should be turned off immediately after completing measurement.**
3. **All the readings must be taken as quick as possible.**

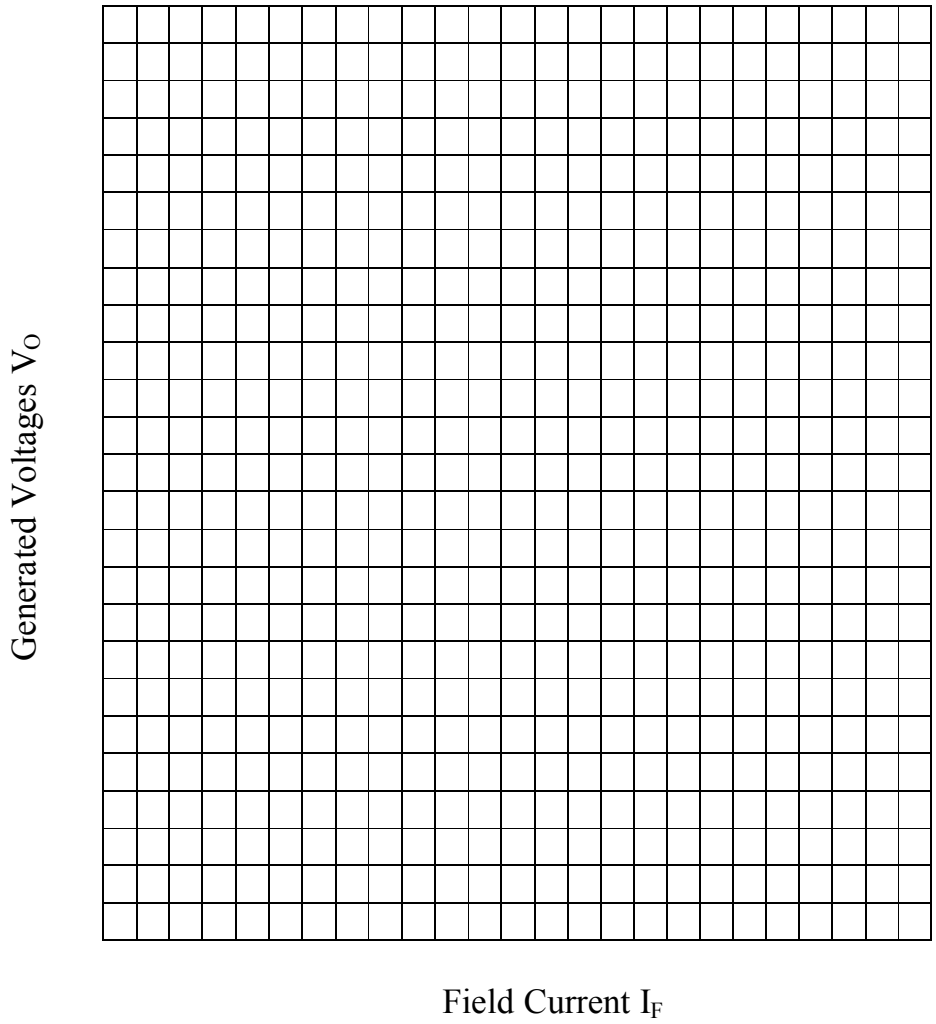
OBSERVATIONS:

Shunt Field Current I_F in Amp.	**0.0**	**0.05**	**0.1**	**0.15**	**0.2**	**0.25**	**0.3**	**0.35**	**0.4**	**0.45**	**0.5**
Shunt Field Current I_F in Amp. (Exact)											
Open Circuit Voltage V_0 in Volt.											

Table 1

GRAPH:

Plot a graph of the output voltage V_0 for various values of field current I_F from the readings in observations Table 1.



CIRCUIT CONNECTIONS (SELF EXCITED DC SHUNT WOUND GENERATOR)

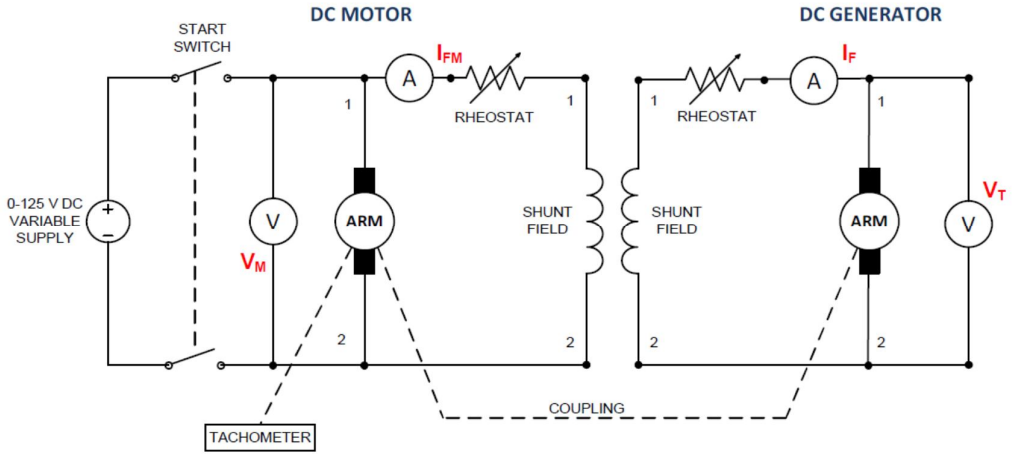


Figure 1.2

PROCEDURE:

1 Place the two machines on the bedplate with the motor on the left and the generator on the right.

2 Couple the machines tightly using the coupling. Be sure the coupling fits snugly inside both shafts.

3 Clamp the machines tightly to the bedplate.

4 Make the motor connections shown in Fig. 1.2 but do not turn the power ON yet. Turn the knob of the 0-125 variable DC supply fully counter clockwise to its zero position. Turn the motor's field rheostat knob fully counter clockwise to its minimum resistance position.

5 Make the generator connections shown in Fig. 1.2 Turn the generator's field rheostat knob fully clockwise to its minimum resistance position.

6 Have the teacher check your connections to be sure they are correct.

7 Turn ON the main AC circuit breaker; turn ON the 0-125 volt DC supply circuit breaker; and turn ON the circuit breaker switch that starts the motor.

8 Slowly turn the knob of the 125 volt supply fully clockwise to its maximum output position. The motor should now be running. With the tachometer directed at the motor shaft, turn the motor's field rheostat knob clockwise until the motor is rotating at 1800 rpm.

9 At this point there is maximum current in the field coil. Record the exact value of field current and generated voltage in observations Table 2.

10 Slowly turn the generator's field rheostat knob supply until the ammeter reads approximately 0.45 amps of field current. It is not important that the field current be exactly 0.45 amps. If you overshoot, stop and take your reading there.

11 Record the exact value of field current and generated voltage in observations Table 2

12 Repeat Steps 10&11 for the approximate values of field current given in the observation Table 2.

13 Turn OFF all circuit breaker switches. Disconnect all leads.

CAUTION!

4. **High voltages are present in this experiment. Do not make any connections while the Power is on.**
5. **The power should be turned off immediately after completing measurement.**
6. **All the readings must be taken as quick as possible.**

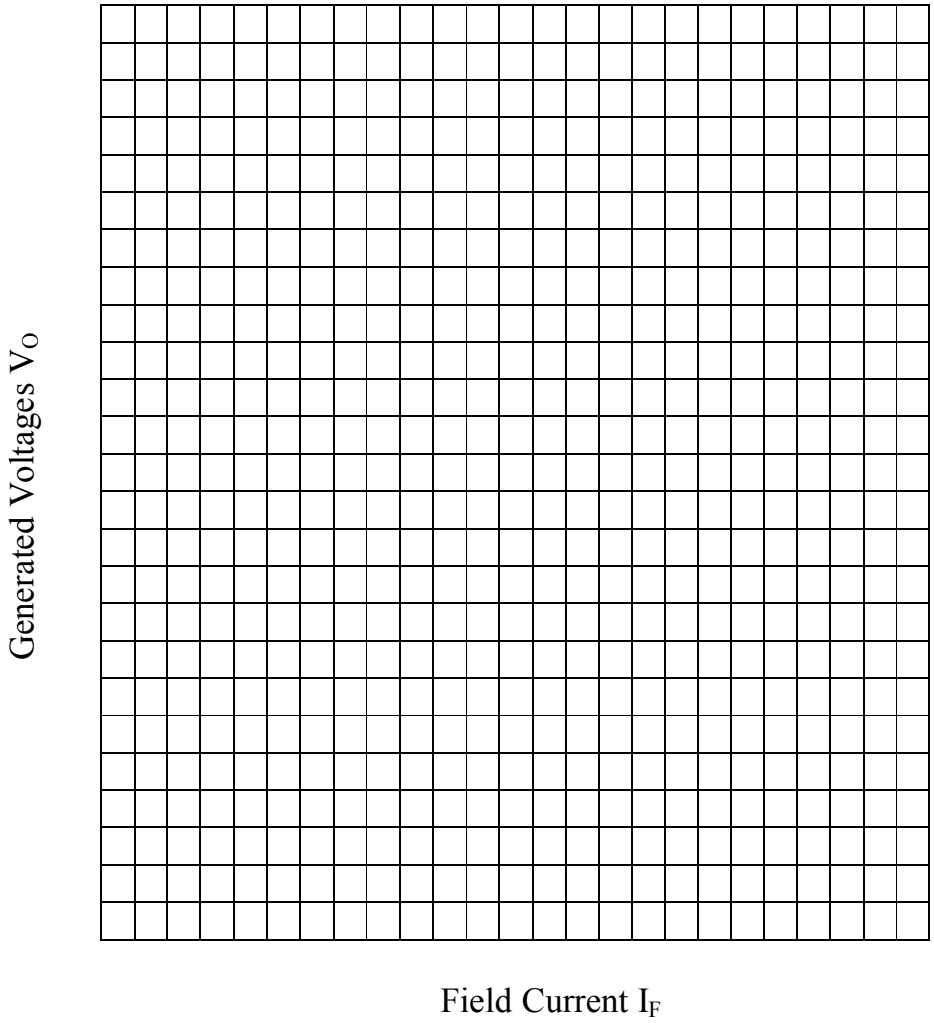
OBSERVATIONS:

Shunt Field Current I_F in Amp.	**0.5**	**0.45**	**0.4**	**0.35**	**0.3**	**0.25**	**0.2**	**0.15**	**0.1**	**0.05**	**0**
Shunt Field Current I_F in Amp. (Exact)											
Open Circuit Voltage V_0 in Volt.											

Table 1

GRAPH:

Plot a graph of the output voltage V_0 for various values of field current I_F from the readings in observations Table 2.



REPORT

Prepare a report containing:

1. Diagrams of each circuit.
2. All tables.
3. Graph on a grid paper.
4. All calculations and required data.
5. Answers to questions.

REVIEW QUESTIONS

1. Describe the curve of the No-load characteristic of a Separately-excited DC generator, V_0/I_F at constant speed.

2. Describe the curve of the no-load characteristic of a Self-excited DC generator, V_0/I_F at constant speed.

3. Current flowing through the field coils:

	a	Magnetizes the pole pieces.
	b	Makes the generator armature turn.
	c	Has no effect on the generator magnetic field.

4. The process of magnetizing the pole pieces involves:

	a	Passing a magnetic field through them without change.
	b	Lining up the internal magnets of the pole pieces.
	c	Trying to get the tiny internal magnets of the pole pieces into random helter-skelter positions so their fields cancel.

5. The terminal voltage of a given generator depends on these two things:

	a	The magnetic field strength and armature speed.
	b	The field current and armature speed.
	c	Resistance of the field coil and armature speed.

6. A field pole piece is said to be saturated when:

	a	A small increase in field current produces a large jump in magnetic field strength.
	b	Magnetic field strength increases when there is no increase in field current.
	c	Increases in field current produce proportionally smaller increases in magnetic field strength.

7. Hysteresis is the term used to described

	a	The way iron can become magnetized.
	b	The way iron can become saturated.
	c	The way a decrease in magnetic field strength lags behind a decrease in field current.

8. The resistance of the shunt field coil is:

	a	Higher than the series field coil.
	b	Lower than the series field coil.
	c	The same as-the series field coil.

9. The size of the wire of the series field coil as.

	a	larger in diameter than the shunt field coil.
	b	Smaller in diameter than the shunt field coil.
	c	The same in diameter than the shunt field coil.

FINAL CHECKLIST

All the students must make sure, before they leave the Lab:

1. Turn the value of variable power supplies and resistive load to zero
2. Main power switch on the work bench is put "OFF".
3. All the connection of machines/ equipment is removed.
4. All machines/meters are properly placed (slide in) either in storage cabinet or in work station itself.
5. All connecting leads are sorted out according to their length and colours and placed on the hooks provided in the side of the work station.
6. Submit your answers to the questions, together with your data, calculations (if any) and results before the next laboratory sessions.